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Snake oil and pangolin scales: insights into wild animal use at “Marché des Fétiches” traditional medicine market, Togo

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Abstract

Traditional medicine beliefs are culturally important in some West African communities, where there is a thriving domestic consumer demand for wild animal derivatives. Yet, such practices can threaten the conservation of wild populations and negatively impact animal welfare. To identify those species most likely to be affected, we investigated wildlife derivative trade at the largest fetish market of West Africa in Togo. Specifically, we asked what wild animals or animal products were most profitable, which wild animals were perceived by vendors to have increased most in rarity and what they were used for. A key question was whether vendors also sold plant-based alternatives. Vendors provided 36 local animal names, from which we inferred an estimated 281 species. Thirteen percent of these inferred species are categorised on the IUCN Red List as threatened ($n = 35$); 26% are declining ($n = 72$). The most commonly cited most

profitable wildlife derivatives were “Pangolin” and “Python”; the most commonly cited most profitable live wild animal was “Chameleon”. Overall, wildlife use was predominantly spiritual rather than medicinal. Plant-based alternatives were available, but comprised < 40% of sales and appeared to be considered less important or less useful than wild animal products. The legal status of this domestic trade in Togo is unclear given the existence of potentially conflicting national legislation. In addition to further research focused on the actual impacts on populations and individuals of the species indicated, socio-economic importance of this trade, societal pressures driving consumer demand and an assessment of the feasibility of sustainable plant-based alternatives is warranted.

Keywords

Animal Welfare, Conservation, *Phataginus tricuspidis*, *Python regius*, Wildlife Trade

Introduction

For millennia, traditional healers have used wildlife with the intention of maintaining human well-being and to treat, diagnose or prevent sickness, based on both observable physical symptoms or perceived supernatural forces (Alves and Rosa 2013). Such practices remain widespread; in the 1990s, approximately 80% of the global human population was thought to still rely primarily on animal and plant-based medicines (WHO/IUCN/WWF 1993). As a result, wildlife used as traditional medicine remains extremely varied, involving a vast array of species from all taxonomic groups (e.g. Soewu 2008; Williams et al. 2014; Svensson et al. 2015). Although, in some situations, traditional medicine is categorised, controlled and practised publicly, in others it remains clandestine, supernatural and localised (World Health Organization 2002).

Traditional medicine and fetish beliefs have been identified as being important for the culture of African people, especially in the central (Pauwels et al. 2003), southern (Simelane and Kerley 1998; Herbert et al. 2003) and western (Fretey et al. 2007) countries where there is a thriving domestic consumer demand for wild animals and their derivatives (e.g. Djagoun et al. 2018). It has been suggested that their decision to consult a traditional healer and/or purchase traditional medicine may be because traditional healers are far more accessible than university-trained medical doctors to most of the population in these countries, particularly those living in rural areas, where there is a relatively low ratio of doctors to patients (Williams 2007; Williams and Whiting 2016).

When carried out unsustainably, the use of wildlife as traditional medicine, whether used legally or illegally, can threaten the conservation of wild populations through biodiversity loss and species loss (Moorhouse et al. 2020). It also has negative impacts on wild animal welfare during capture, captive breeding, transport, sale and slaughter (Baker et al. 2013). Furthermore, from a domestic perspective, more than half of human global population growth between now and 2050 is expected to occur in Africa (United Nations 2018). From an international perspective, there also are concerns that illegal actors are increasingly sourcing wildlife from African countries for traditional medicine uses elsewhere [e.g. African pangolins (*Manidae* spp.) for use in China (Ingram et al.

2018)]. In light of these predicted trends alone, it is clear that Africa will play an increasingly central role in shaping the scope and scale of the use of wildlife as medicine and its impact on the animals involved, in the decades to come (Williams et al. 2014).

One of the difficulties in tackling potentially unsustainable wildlife trade is identifying those species that are most at risk and thus warrant intervention. In this regard, market surveys can be useful where wildlife and their derivatives are sold (Harris et al. 2015). The trade in wildlife as traditional medicine in southern Africa is thought to be significant and widespread; however, it remains poorly understood (and little recognised in scientific literature) with only baseline data having been collected for a relatively few select areas in Southern Africa (but see, Simelane and Kerley 1998; Whiting et al. 2011; Segniagbeto et al. 2013; Williams and Whiting 2016; Djagoun et al. 2018; Dossou et al. 2018). In Togo and other West African countries, studies are particularly lacking. A previous study of the “*Marché des Fétiches*” (French for fetish market), situated in Lomé (the largest fetish market in West Africa) by Segniagbeto et al. (2013) was restricted to reptiles. These initial studies point to the growing need for baseline data on the species most used, the nature of their use and the socio-economic importance of the trade and to identify those species that might be threatened by over-exploitation or subject to inhumane use. Studies to better understand consumer demand and to consider appropriate alternatives, such as sustainable “herbal” (plant-based) substitutes (Moorhouse et al. 2020), have also been recommended.

The focus of our study was the traditional medicine market, the “*Marché des Fétiches*”, in Lomé, the capital city of Togo. Through socio-economic questionnaires, we aimed to gain insight into the diversity of species sold and their commercial and medicinal value. In particular, we sought to identify: (1) those species perceived to be most commercially profitable by traders (i.e. those that sold for most money), both in terms of live animals and their derivatives; (2) those species deemed to have increased most in rarity; and (3) initial information regarding the vendors’ knowledge of any herbal alternatives to these wildlife-based derivatives. Our objective was to identify potential conservation threats and welfare concerns, to provide preliminary information on the nature of consumer demand and the current availability of plant-based alternatives.

Methods

Survey area

The “*Marché des Fétiches*” is situated in Akodessewa in the east of Lomé, the capital city of Togo (Segniagbeto et al. 2013). Since the late 1990s, the “*Marché des Fétiches*” has grown to be the largest market for traditional medicine in West Africa (Segniagbeto et al. 2013). Although bush meat is sold at other markets in Lomé, it has not been openly observed for sale at the “*Marché des Fétiches*” (Segniagbeto, pers. comm.). The market ultimately services the urban population from the city, as well as rural and urban healers and consumers from neighbouring areas seeking to purchase products

which they are unable to source locally (Segniagbeto et al. 2013). The market was moved from Bè market “Marché de Bè” to Akodessewa in 1998 and, since 2013, has also operated as a tourist attraction. As such, the throughput and turnover of some wildlife derivatives may be low in comparison to other markets elsewhere (with parts of some species remaining at stalls for years, serving as ornaments to draw tourist attention, with only small pieces being sold at irregular intervals). Wildlife trade is conducted openly at the market, even though some species are protected under national legislation. For example, Segniagbeto et al. (2013) reported the sale of several reptile species [e.g. marine turtles (*Chelonioidae*) and pythons (*Pythonidae*)] that were legally protected in Togo under Article 62, Section 2, Chapter II of law N° 2008-005, regulating environment protection and wildlife conservation.

Data collection

Interviews were conducted by four local field staff asking a set of predetermined questions that included open-ended, closed and multiple-choice questions (see Appendix 2). Interviews were conducted in Ewe, Fon and French and later translated into English. Surveys were carried out with vendors at five of the eight stalls that were in operation at the time. Vendors were interviewed once in September (22nd–23rd) 2018 on trade in wildlife and a second time in February (19th–20th) 2019 on plant-based alternatives. Vendors who were willing to participate in the study were identified through a process of chain referral (Newing 2011), whereby participants recommended other potential participants or persuaded others to take part. In accordance with the British Sociological Association Statement of Ethical Practice (BSA 2017), informed consent was obtained verbally from every survey participant prior to the interview, participants were made aware of their rights to voluntarily participate or to decline, no identifying participant or household data were collected and the database collated was entirely anonymous. In addition, vendor stands were coded in the database and names not reported to further protect study participants from harm or discrimination (St. John et al. 2016).

Specifically, vendors were asked to identify and rank the 10 wild animals (using local common names and excluding invertebrates) that they currently considered to be the most profitable (with wildlife body parts and live animals considered separately) and the 10 wild animals that they considered to have most increased in rarity (and therefore inferred reduced availability) over the past five years. Vendors were also asked to provide additional information including the wildlife body parts sold, their minimum and maximum price, estimated number of units sold (in the last year, last five years and last 10 years) and their intended medicinal / spiritual purpose. Interviews also involved additional questions focused on “Python” (*Python* spp.) and “Pangolin” (*Manidae* spp.) as these common names were most commonly cited as being the most profitable wildlife species sold as derivatives at the market following initial questions (see Appendix 2). Python/pangolin-specific questions focused on specific body parts

sold, purpose and price per item, source locations, estimated number of animals sold, customer type [tourists (1 visit), casual customers (< 5 visits per year) and regular customers (> 5 visits per year)] and species availability (a mean “availability score” was calculated based on respondents’ answer to the question on how available pangolin / python is now, compared to five years prior) (see Appendix 2).

The same vendors were also asked questions related to the sale of plants as traditional medicine (see Appendix 2). Initial questions focused on whether they had any awareness of plant-based items that could be used to treat medical and/or spiritual issues and, if so, could they identify the three most common plant-based items sold and state their purpose. They were also questioned regarding whether they themselves sold any plant-based items, if not why this was the case and, if so, to provide an estimate of the proportion of their sales that involved plant-based items. Vendors were also specifically asked about their awareness of any plant-based items that could be used as direct replacement for “Python” (*Python* spp.) and “Pangolin” (*Manidae* spp.). The availability of plant-based items at a herbal market in Lomé was confirmed using local common names (see below) provided by vendors.

For both wildlife and plants, local common names provided by vendors in Ewe and Fon were translated into English. A list of inferred species and their respective scientific names were assigned to each common name based on the documented presence of wild populations in Togo, according to Amori et al. (2016) and Segniagbeto et al. (2007, 2011, 2014, 2015). Where taxonomy differed in more recently published assessments, we used scientific names according to the International Union for Conservation of Nature Red List of Threatened Species (IUCN 2020, hereafter the IUCN Red List). For all species, information regarding their conservation status was also gathered from global species assessments on the IUCN Red List because national level assessments are not yet available for Togo. Threat status was recorded in accordance with the 2001 IUCN Red List Categories and Criteria system (version 3.1) as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) or Data Deficient (DD). For all species, information regarding their international legal trade status was gathered from the Convention on the International Trade in Endangered Species of Flora and Fauna website (<https://www.cites.org>).

Data analysis

We used descriptive statistics to describe patterns and trends in the data to determine if the frequency of species and type of wildlife product, cited as being the most profitable body part, were distributed similarly. Statistical analysis was carried out using R statistical software version 3.4.1 (R Core Team 2017). Wilcoxon-signed rank tests were used to compare cost between medicinal and spiritual sales and a Spearman correlation was used to test for a relationship between product cost and the number of items sold (please note, costs were not adjusted to allow per kg comparison). Monetary values were reported in West African CFA Francs (CFA) and converted to US dollars (USD)

using 1 CFA = 0.0017 USD (conversion rate as of 21.06.19, <https://www.xe.com>). To provide a preliminary visual overview of the types of uses for animals and/or their derivatives sold, uses communicated by the traders were simplified, summarised and then categorised into short word strings. The words in the strings were hyphenated in places to keep them together to generate word clouds produced by the “wordcloud” package in R in which the sizes of the words are proportional to the frequency with which the words (i.e. uses) occurred (i.e. were mentioned by traders). The packages “tm”, “SnowballC” and “RColorBrewer” were also used to create the word clouds (cf. Forrester et al. 2017). A word cloud was generated for the number of times a common name was associated with a use, thereby indicating the animals with the most number of uses mentioned by the traders. We did not attempt to categorise uses into themes or to carry out an in-depth thematic analysis, due to consideration of content variability (i.e. vendor answers relate to both product value and rarity of a range of different types of products that likely differ in their uses) and small sample size (five vendors interviewed). The reported frequency in the word clouds reflects both the number of vendors using a particular word and the number of times the same word was used by a vendor. Therefore, the resulting word clouds, provided herein, cannot be used to distinguish between words that were used repeatedly by only a single vendor and those that were used repeatedly by several vendors.

Results

Three male and two female vendors, whose ages ranged from 17 and 45 years, participated in our study. Participants consisted of both married and single individuals from the Fon and Watchi tribes who lived in households with between two and six people, with between zero and six children. All participants were educated to primary school level, all were animists and were originally from Benin (Abomey), having moved to Lomé, Togo. All participants stated that they used traditional medicine as their main form of income (actively trading between two and 30 years) with an estimated income of between 1,644 USD and 20,552 USD per year.

Overall, during our questionnaire, participants used 36 distinct different common names to refer to the wildlife species traded (Fig. 1a; Suppl. material 2). The most frequently mentioned common names ($n = 130$ total responses from five vendors for the ten most profitable body part / live animal that you currently sell including the price and purpose) were “Lion” (*Panthera leo*) ($n = 9$; 7% of responses), “Python” (*Python* spp.) ($n = 8$; 6%), “Chameleon” (*Chamaeleo* spp.) ($n = 8$; 6%), “Viper” (Viperidae) ($n = 7$; 5%), “Pangolin” (Manidae) ($n = 7$; 5%), “Big cat” (Felidae) ($n = 7$; 5%), and “Crocodile” (Crocodylidae) ($n = 7$; 5%) (Fig. 1a). The most frequently-cited type of product traded was a live animal ($n = 43$; 33%), followed by the entire dead animal ($n = 31$; 24%), skin ($n = 20$; 16%) and head ($n = 19$; 15%) (other parts sold included bile, bones, feathers, feet, head, scales, skin, teeth and toes, Appendix 2). Overall, 28 different medicinal and spiritual uses were cited by participants (Fig. 1b). The most commonly-cited uses ($n = 117$ total uses from five vendors for the ten most profitable



Figure 1. Word cloud of **a** the cited common names provided by vendors when asked to list the most profitable wildlife derivatives, most profitable live wild animals and those species that have most increased in rarity ($n = 130$ total responses) and **b** the cited purposes provided by vendors when asked to list the most profitable wildlife derivatives, most profitable live wild animals and those species that have most increased in rarity ($n = 117$ total responses). Size of text is proportional to frequency of words in interviews. Frequency reflects both the number of vendors using the word and the number of times the word was used by the vendor.

body part / live animal that you currently sell including the price and purpose) were “protection” ($n = 18$; 15%), “anti-venom” ($n = 15$; 13%), “witchcraft” ($n = 15$; 13%) “good luck charms” ($n = 11$; 9%) and “fetish objects” ($n = 9$; 8%) (Fig. 1b).

Across all species and product types, at the time of asking, items sold for between 0.26 USD (for a single “Chameleon” body part) and 765 USD [for a “Hippopotamus” head (*Hippopotamus amphibius*)] and the number of items sold per vendor for each product ranged between 10 [for individual live “Cobra” (Elapidae), “Monitor lizard” (Varanidae), “Python” and “Viper”] and 600 items (for live “Chameleon”) (Suppl. material 1). The most expensive individual items were derived from “Hippopotamus” (765 USD), “Warthog” (*Phacochoerus africanus*) (425 USD), “Hyena” (200 USD), “Lion” (79 USD), “Sea turtle” (Cheloniidae / Dermochelyidae) (77 USD) and “vulture” (Accipitridae) (72 USD), followed by “Squirrel” (Sciuridae), “Baboon” (Cercopithecidae), “Parrot” (Psittaciformes), “Crocodile” (Crocodylidae), “Pangolin” (Manidae) and “Eagle” (Accipitridae) (min/max = 18/43 USD, Appendix 2). The items sold in the highest numbers were live “Chameleon” (600 animals), “Viper” (500 animals), “Honey badger” [*Mellivora capensis* (300 animals)], “Cobra” (200 animals), “Monkey” [Cercopithecidae (200 animals)] and “Turtle” [Testudines (200 animals)] (Appendix 2). The least expensive individual items were derived from “Chameleon” (0.26 USD), “Frog” [Amphibia (0.34 USD)], “Pangolin” (0.34 USD), “Sparrow Hawk” [*Accipiter* sp. (0.34 USD)] and “Shrew” [Soricidae (0.51 USD)] (Appendix 2). The items sold in the least numbers were live “Cobra”, “Python”, “Monitor lizard” and “Viper” (all 10 animals, respectively) (Appendix 2). No correlation was found between minimum price and the number of items sold ($\rho = 10.17$, $n = 41$, $P = 0.29$).

The two most commonly cited “most profitable wildlife derivatives” originated from “Pangolin” (four of the five vendors interviewed) and “Python” (four vendors), followed by “Lion” (three vendors), “Owl” (Strigidae spp.) (three vendors) and “Viper” (three vendors) (Fig. 2). All five vendors listed “Chameleon” as amongst the most profitable live wild animals. The other most profitable live wild animals were “Cane Rat”, “Cobra”, “Monitor lizard”, “Python”, “Turtle” and “Viper” (all three of the five vendors, respectively) (Fig. 2). In total, 15 species were cited as profitable as both derivatives and as live animals by at least one of the five vendors; ten were cited only as profitable as derivatives and seven species only as profitable as live animals (Fig. 2). With regards to increased rarity, all vendors suggested that “Lion” and “Big cats” had declined. The other species stated to have most increased in rarity were “Baboon”, “Crocodile”, “Elephant”, “Hyena” and “Pangolin” (all two of the five vendors, respectively) (Fig. 2). Seventeen species were identified as having become rare by at least one of the vendors.

Overall, during our questionnaire, participants used 16 different common names to refer to the plants sold as traditional medicine (Suppl. material 2), although the five vendors appeared to sell different plant species (there was no single plant species sold by all five vendors). The most commonly-cited plant-based alternatives were “Akouema” ($n = 3$; 60%) and “Hehema” ($n = 3$), followed by “Ahehe” ($n = 2$), “Midohoungbe” ($n = 2$) and “Olikpekpe” ($n = 2$). All five participants acknowledged their awareness

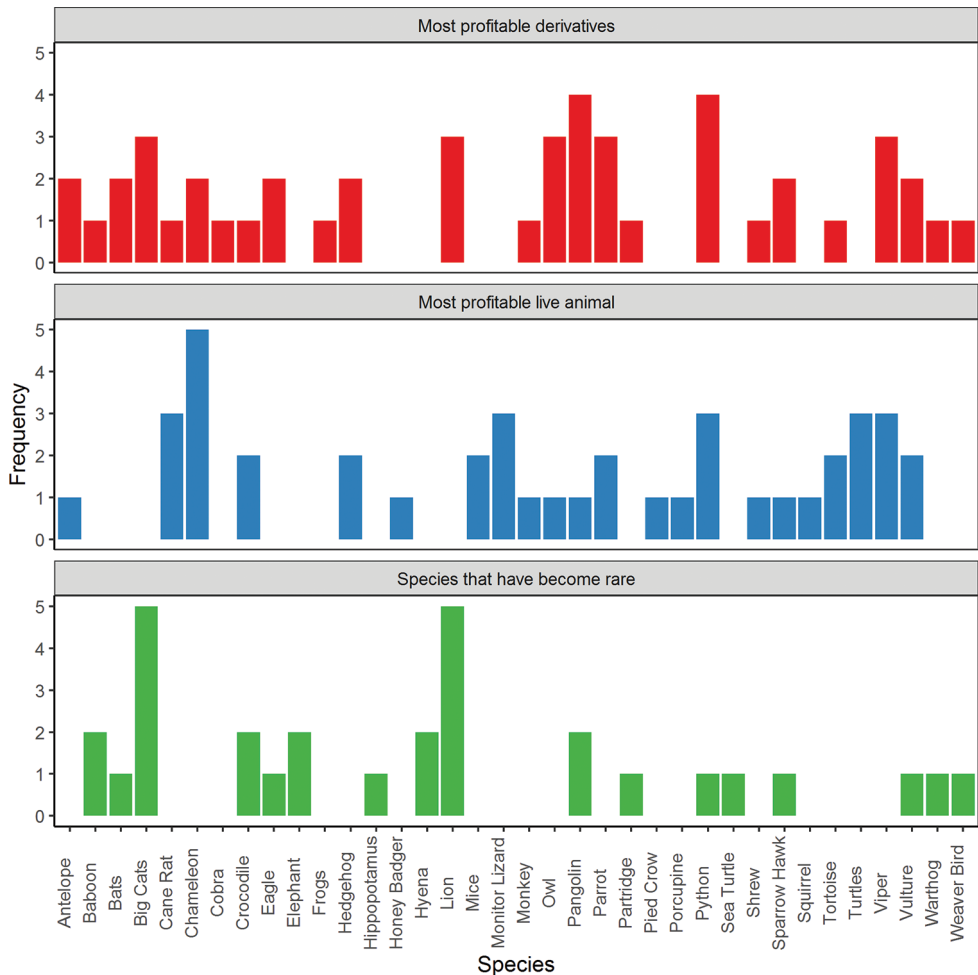


Figure 2. Frequency of species described by respondents as having the most profitable derivatives, most profitable as a live animal and species they considered to have most increased in rarity.

of herbal alternatives; however, only three confirmed that they prescribe any medical treatments / spiritual items that are plant based. All five participants reported that > 60% of the products sold were of wild animal origin. They also stated that animal derivatives were required in combination with herbal products; and one suggested that wild animal-based derivatives were more powerful. Although herbal vendors provided samples for all of the plant-based products, none of the samples could be identified due to the partial dried nature of the specimens.

Overall, we estimate that the 36 distinct common names potentially refer to at least 281 different extant species in Togo, including 49 amphibians (Amphibia), 59 birds (Aves), 140 mammals (Mammalia) and 33 reptiles (Reptilia) (assuming that a common name could refer to multiple species in the same taxa, for example, order, family or

genus) (Suppl. material 2). With regards to international conservation status, seven of these inferred species are currently considered to be Critically Endangered [Togo slippery frog (*Conraua derooi*), Nubian flapshell turtle (*Cyclanorbis elegans*), White-backed vulture (*Gyps africanus*), Rüppell's vulture (*Gyps rueppelli*), Slender-snouted Crocodile (*Mecistops cataphractus*), Hooded vulture (*Necrosyrtes monachus*) and White-headed vulture (*Trigonoceps occipitalis*)], four species are Endangered [Green sea turtle (*Chelonia mydas*), African grey parrot (*Psittacus erithacus*), Egyptian vulture (*Neophron percnopterus*) and Lappet-faced vulture (*Torgos tracheliotos*)], 24 are Vulnerable, 11 are Near Threatened, 216 are Least Concern, 12 are Not Evaluated and seven are Data Deficient [i.e. Togo screeching frog (*Arthroleptis brevipes*), Necas's chameleon (*Chamaeleo necasi*), Kintampo rope squirrel (*Funisciurus substriatus*), *Hylomyscus pamfi* (Rodentia: Muridae), Eroded hingeback tortoise (*Kinixys erosa*), *Leimacomys büttneri* (Rodentia: Muridae) and Walter's duiker (*Philantomba walteri*)] (Appendix 1; Suppl. material 2).

With regards to their population status, eight inferred species have wild populations considered to be increasing, 80 that are stable, 72 that are decreasing and 121 of unknown population status (Appendix 1; Suppl. material 2). With regards to international legal status, eight inferred species [Cheetah (*Acinonyx jubatus*), *Chelonia mydas*, Leatherback sea turtle (*Dermochelys coriacea*), Olive Ridley sea turtle (*Lepidochelys olivacea*), White-bellied pangolin (*Phataginus tricuspis*), African dwarf crocodile (*Osteolaemus tetraspis*), leopard (*Panthera pardus*) and *Psittacus erithacus*] are currently listed on CITES Appendix 1, four species have populations listed on Appendix 1 and Appendix 2 (*Caracal caracal*, *Crocodylus niloticus*, *Loxodonta africana* and *Panthera leo*), 65 species are listed on Appendix 2 and 202 are not currently listed on any of the CITES Appendices (see Appendix I; Suppl. material 2). Vendors also inferred an additional 91 species (32%) that are not currently considered as threatened, but have greatly increased in rarity from their perspective (Fig. 2).

Species case studies (pangolin and python)

Pangolin findings

A total of eight of the ten different stated pangolin body parts are used for medicinal purposes according to the vendors who participated in this study (Fig. 3). Three of the five vendors referred to the use of pangolin “scales” and two to the use of pangolin “foot”, the “entire animal”, “head” or “penis” (Fig. 3). With regards to medicinal use, a total of nine different treatments were cited; however, the treatment of asthma was most frequently cited by vendors ($n = 5 / 15$ responses; 33%) (Fig. 4a). Vendors stated that the sale of an entire pangolin could fetch up to 51 USD and a penis up to 43 USD (mean price per body part and purpose shown in Fig. 3).

Each of the five vendors reported a different pangolin body part used for spiritual purposes: the “entire animal”, “foot”, “head”, “sex organ” or “tongue” (Fig. 3). Two vendors reported that, with regards to spiritual use, pangolin body parts were used to remove

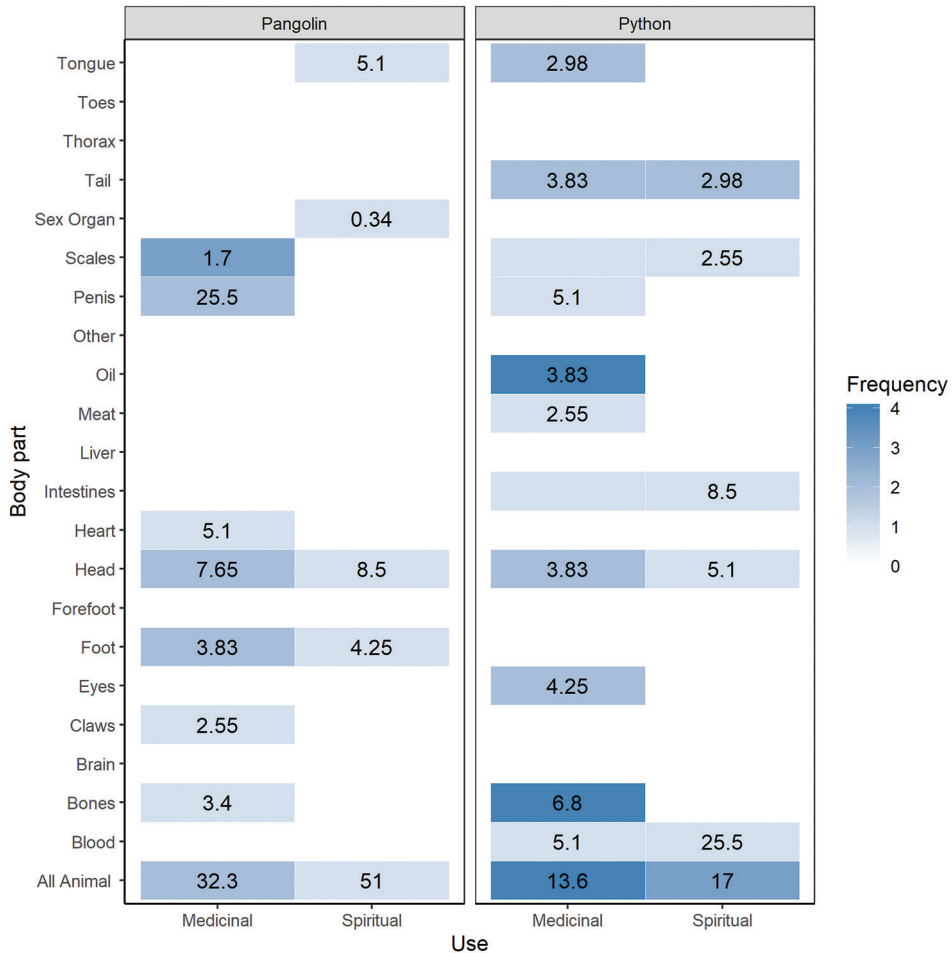


Figure 3. Frequency of cited purpose and body part used for the two focal species “Pangolin” and “Python” with information on average prices in USD provided in the blue cells. Blank cells refer to body parts that were mentioned by vendors but no price information was provided. Shading of the blue cells reflects frequency with darker blue being more frequent.

a curse; the other three vendors each gave different spiritual uses: “luck”, “brings money” and “protection” (Fig. 4a). Vendors stated that the sale of 10 scales could fetch up to 3 USD and a head up to 9 USD (means shown in Fig. 3). The mean cost across all body parts was higher when sold for spiritual purposes (13.8 ± 21 USD) than for medicinal purposes (10.3 ± 11.8 USD), but was not significantly different ($W = 17.5$, $P > 0.05$).

With regards to reported source country, two of the vendors stated that they source pangolin derivatives from within Togo, all of the vendors stated that they source pangolin derivatives from Benin, one of the vendors stated that they source them from Ghana and four of the vendors stated that they source them from Nigeria. Three vendors stated that they source pangolin derivatives directly from hunters and three that



Figure 4. Word cloud of the cited medicinal and spiritual purposes of pangolin ($n = 19$ total responses) **a** and python ($n = 28$ total responses) **b** provided by vendors. Size of text is proportional to frequency of words in interviews. Frequency reflects both the number of vendors using the word and the number of times the word was used by the vendor.

they source them from middlemen. On average, vendors stated that they sold the equivalent of 30 pangolins over the last year, 137 over the last five years and 281 over the last 10 years. The mean availability score of pangolins over the last five years was 4.5 with three of the vendors stating that there were “quite a lot less” pangolin available compared to five years previous. Vendors identified four different local common names (“Kangao”, “Midohoungbe”, “Olikpekpe” and “Tchechema”) with reference to plant species that could be sold in place of pangolin derivatives for medicinal and/or spiritual purposes (Suppl. material 2).

Python findings

All of the 12 different stated python body parts are used for medicinal purposes, according to the vendors who participated in this study (Fig. 3). Four of five vendors reported selling python “bones”, the “entire animal” and python “oil” for medicinal purposes, two vendors reported selling the “eyes”, “head”, “tail” and “tongue” (Fig. 3). With regards to medicinal use, a total of ten different treatments were cited; however, general “protection” ($n = 5 / 20$; 25%) was most frequently cited by vendors, followed by use of oil for massages (Fig. 4b). Vendors stated that the sale of an entire python could fetch up to 26 USD, bones and a spoonful of oil up to 9 USD (means shown in Fig. 3).

A total of six of the 12 different python body parts are used for spiritual purposes, according to the vendors who participated in this study (Fig. 3). Two of the five vendors reported selling the “entire animal” ($n = 2 / 5$; 40%) and one each the “blood”, “intestines”, “scales” and “tail” (Fig. 3). Two specific spiritual uses were given for python body parts: witchcraft and as anti-venom; the ability to protect against witchcraft being most frequently cited by vendors (for all python body parts; $n = 7 / 8$; 88%) (Fig. 4b). Vendors stated that the sale of a spoonful (5 ml) python blood could fetch up to 26 USD and intestines could fetch up to 9 USD (Fig. 3). The mean cost across all body parts was higher when sold for spiritual purpose (10.3 ± 9.2 USD) than for medicinal purposes (5.2 ± 3.2 USD) but was not significantly different ($W = 22$, $P > 0.05$).

One of the five vendors stated that they do not sell pythons, because it is considered as a sacred animal by the “Pedah” ethnic group. The four vendors that did sell pythons reported that they sourced them from within Togo, from Benin and from Nigeria. One of these four vendors also stated that they source pythons from Ghana. On average, vendors reported that they have sold the equivalent of 109 pythons over the last year, 338 over the last five years and 675 over the last 10 years. The mean availability score of pythons over the last five years was 4.5 with two vendors stating that there were “quite a few less” and two that there were “quite a lot less” available compared to five years previously. Vendors identified four different local common names (“Akouema”, “Canabis”, Djokotche” and “Zodi”) with reference to plant species that could be sold in place of python derivatives for medicinal and/or spiritual purposes.

A summary of the cost per body part, sources (both from where and from whom), sales and availability scores of the two focal species are shown in Figure 3 (see also Appendix 2). The most expensive species, according to the five vendors interviewed, was the pangolin (the entire dead animal) sold for spiritual (51 USD) and medicinal purposes (32.3 USD). The most frequently sold of the two species over the last ten years was the python (their heads and as a live animal). For both species, Benin was cited most frequently as the source (by all five vendors), followed by Nigeria (four vendors), Togo (two vendors) and Ghana (one vendor). For both python and pangolin, products were sourced more often directly from hunters, rather than from a middleman, and by “regular customers” rather than locals or tourists buying out of curiosity.

Discussion

Our study confirmed that a wide variety of live wild animals and their derivatives are being sold at the “Marché des Fétiches” in Togo (Figs 5, 6). Interestingly, all of the vendors at this market were from Benin, with some of them having relied on the sale of traditional medicine involving wild animal derivatives for up to 45 years. In terms of specific use, vendors stated that the majority of wildlife was used for spiritual use rather than medical purposes (Fig. 1b). The most-cited purpose for vendor 1 was “fetish object”, vendor 2 – “against witchcraft”, vendor 3 and 4 – “good luck charm” and vendor 5 – “protection”. Anti-venom was also a cited purpose across all the vendors.



Figure 5. **A** Entrance to the “Marché des Fétiches”, Akodessewa, Lomé, Togo **B** African grey parrot (*Psittacus erithacus*) intended for commercial sale **C** West African slender-snouted crocodile (*Mecistops cataphractus*) intended for commercial sale **D** live vulture (Accipitridae sp., cf. *Gypohierax angolensis*, Palm nut vulture) intended for commercial sale, Togo, West Africa. Images **A–D** Neil D'Cruze / World Animal Protection.

Vendors provided a total of 36 different common local names (inferring an estimated 281 species) when asked to confirm the wild animals that they considered to be the most profitable and to have most increased in rarity. Our study reiterates the conservation concerns associated with this type of commercial trade activity in West Africa (Djagoun et al. 2018). According to the IUCN Red List of Threatened Species, a considerable proportion of the wild animals, thought to be sold at this market, are already considered to be threatened (13%; 35 inferred species) or to be declining [(26%; 72 inferred species), Appendix I, Suppl. material 2]. Vendors also referred to an additional 32% species ($n = 91$) that are not currently listed on the IUCN Red List as threatened,

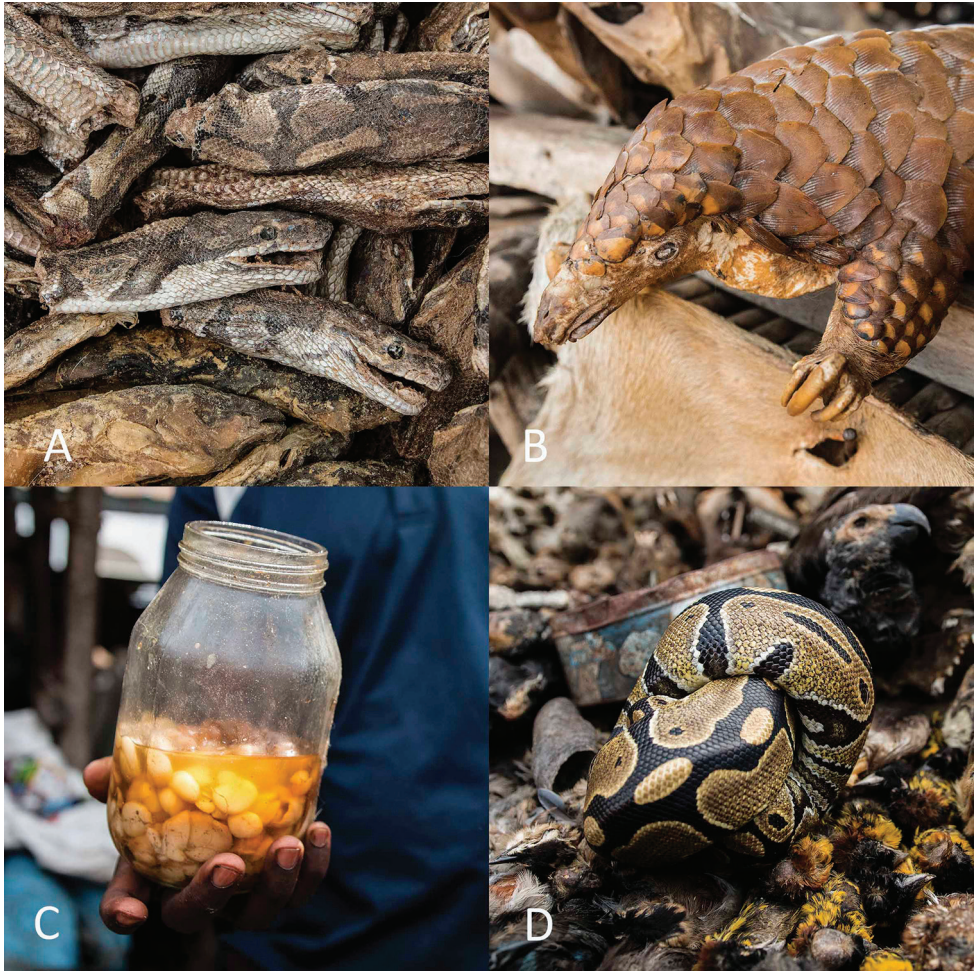


Figure 6. **A** Ball python heads (*Python regius*) intended for commercial sale **B** pangolin (*Phataginus tricuspis*) intended for commercial sale **C** Ball python fat bodies / oil intended for commercial sale **D** live Ball python intended for commercial sale, Togo, West Africa. Images **A–D** Neil D’Cruze / World Animal Protection.

but have greatly increased in rarity from the vendors’ perspective. Whilst this type of traditional use is centuries old, growing human populations, increasing human-mediated pressures and globalisation (Esmail et al. in press) might mean that traditional uses that were perhaps once sustainable, may not necessarily be so in future.

Our findings also draw additional attention to the animal welfare concerns associated with this type of activity. During our visits to the market, we observed stalls with thousands of wild animal derivatives for sale, all of which would have suffered to some degree during capture, potential transport, onward sale and slaughter (Baker et al. 2013). However, it is clear that the potential for wild animal suffering extends beyond

slaughter as vendors confirmed that they are also engaged in the commercial sale of a large number of live wild animals. During survey work at this market, researchers observed a number of live animals (including ball pythons, cane rats, chameleons, monitor lizards, crocodiles and vultures) (see Figs 5D, 6D). These animals were kept in poor welfare conditions (e.g. small barren dirty cages, cloth bags and plastic buckets often out of sight from visiting customers) that clearly compromised their health and well-being.

Although this market is promoted as a tourist attraction by domestic and international tour agencies, the legal status regarding this type of commercial trade activity in Togo is unclear, given the existence of a number of different and potentially conflicting pieces of domestic legislation (D'Cruze et al. 2020). For example, Article 61 of the 005 Framework Law on the Environment (2008) requires that hunting is managed in a sustainable manner, which is questionable for many of the species (internationally considered as threatened according to the IUCN Red List of Threatened Species), whose derivatives are being openly sold. However, from an international trade perspective, a considerable proportion of the wild animals sold at this market are currently afforded some level of legal protection (28%; 79 inferred species) via CITES (Appendix I, Suppl. material 2). As such, the purchase of derivatives from any of these CITES-listed species for international export without relevant CITES permits would be illegal. The implications of trade involving the two species identified as being most economically profitable (pangolin and python) are discussed in more detail below.

Pangolins

“Pangolin” was identified as the most commercially viable wild animal derivative by vendors interviewed during our study. Its increased rarity was also suggested by two of the five vendors. This group of African and Asian scaly mammals is considered to be “the most heavily trafficked wild mammal in the world”, used predominantly as traditional medicine and food, but also in rituals, art and magic amongst communities across Africa (Soewu and Sodeinde 2015) and Asia (e.g. Mahmood et al. 2012). By collating local-scale studies, Ingram et al. (2018) found that pangolins are hunted and observed at wildlife markets throughout West and Central Africa and that pressure from hunting has increased. Mounting evidence suggests that, as the availability of Asian pangolins declines and international trade flows increase, traders are increasingly supplying the currently more abundant and less expensive African pangolins to meet Asian demand (Challender and Hywood 2012).

All four African species [the “Endangered” White-bellied (*Phataginus tricuspis*) (Pietersen et al. 2019a), the “Vulnerable” Black-bellied (*Phataginus tetradactyla*) (Ingram et al. 2019), the “Endangered” Giant ground (*Smutsia gigantea*) (Nixon et al. 2019) and the “Vulnerable” Temminck’s ground pangolin (*Smutsia temminckii*) (Pietersen et al. 2019b)] are currently considered to be threatened with extinction, according to the IUCN Red List (IUCN 2020) and commercial international trade was effectively

banned in 2016 (CITES 2016). Clearly, any trade in pangolin parts at the “Marché des Fétiches” represents a potential conservation concern. Although only the white-bellied pangolin is extant in Togo, trade at the “Marché des Fétiches” likely also involves the black-bellied and the giant ground pangolin, given that vendors stated that they also source pangolins from Ghana. In addition, there are a number of animal welfare issues associated with pangolin hunting practices, for example, it can take hours to successfully extricate a pangolin from its burrow or tree den during capture and transport and also concerns remain that a proportion may still be alive when the boiling process begins (D’Cruze et al. 2018).

Pythons

“Python” was identified as the second most commercially viable wild animal derivative by vendors interviewed during our study. Its perceived increased rarity was also stated by one of the five vendors. Two species of python are known to occur in Togo, the Northern African rock python (*Python sebae*) and the Ball python (*Python regius*) (Segniagbeto et al. 2011). Unlike pangolins, commercial international trade in python species from West Africa is largely permitted, given appropriate CITES paperwork is in place. In fact, the Ball python is the most traded CITES listed (Appendix 2) live animal legally exported from Africa (CITES Trade Database 2019) with most specimens intended for onward sale as exotic pets (Auliya and Schmitz 2010; CITES Trade Database 2019). From a domestic trade perspective, the Northern African rock python is used extensively for meat, leather and use in traditional medicine (e.g. Eniang et al. 2008; Fuashi et al. 2019). The use of pythons as traditional medicine has a number of animal welfare implications. Reptiles are recognised in the limited relevant research as being capable of a range of intellectual abilities and states including anxiety, distress, excitement, fear, frustration and pain (Lambert et al. 2019), suggesting that they have the capacity to experience suffering during capture, restraint, transport and subsequent captivity (Baker et al. 2013).

From a conservation perspective, the Northern African rock python has not been evaluated by the IUCN Red List of Threatened Species. However, this species is also not thought to be as widespread as they once were (Areste and Cebrian 2003). Similarly, although the Ball python is currently considered as Least Concern, information regarding the status and impact of commercial trade on wild populations is also lacking (Auliya and Schmitz 2010). Although the majority of live Ball pythons are reported as animals originating from “ranching” operations, there are concerns that current hunting practices to maintain ranch stock target the most vulnerable biological stages (specifically gravid females and neonates) (Auliya and Schmitz 2010; D’Cruze et al. 2020). Additionally, there are concerns that methods used to source wild Ball pythons, such as the digging and destruction of burrows and the improper release of ranched Ball pythons, may also be contributing to an overall reduction in wild populations of

this species (Auliya and Schmitz 2010; D'Cruze et al. 2020) and genetic pollution (Auliya et al. 2020). In light of these other conservation pressures, the large-scale sale of pythons as traditional medicine is also of potential conservation concern.

Herbal alternatives

Our study confirms that a proportion of the vendors who sell wildlife derivatives at the “Marché des Fétiches” in Togo also sell plants as traditional medicine (Suppl. material 2). This is perhaps unsurprising given that other studies in other locations (e.g. South Africa; Williams 2007) have found that the majority of traditional medicines are of botanical origin. In fact, while there is a rich history of research focused on the use of traditional medicinal plants for more than 200 years, research focused on wildlife as traditional medicine in Africa arguably only commenced in the 1980s (Williams and Whiting 2016). However, it appears that studies, focused on the potential use of plants as a humane and sustainable alternative to the use of threatened wildlife species, are largely lacking. Moorhouse et al. (2020) found that plant-based alternatives are likely to be a viable and preferred option for consumers of wildlife as traditional Asian medicine in China, given that they are listed within existing pharmacopoeia and provided by practitioners that do not challenge the existing Chinese belief system. Although the use of botanical-based traditional medicine does not involve animal welfare concerns, it is important to note that careful steps should be taken to ensure that conservation concerns are not transferred to target plant species in West Africa.

Limitations

Establishing the impact of traditional medicine on wildlife is notoriously difficult (Williams and Whiting 2016). In particular, caution is always required in interpreting data derived from interviewees when trade involves some element of illegality and/or unsustainability (e.g. Newton et al. 2008; D'Cruze et al. 2018). For example, given the potentially sensitive nature of the information asked for in our surveys, interviewees might have been reluctant to be honest about the magnitude of their activities or may have unintentionally underestimated sales due to poor memory recall. Conversely, interviewees may have exaggerated the extent of their trade activities, knowingly or unknowingly. As such, there is a risk that the data underestimate or overestimate the impact on wildlife in Togo. With regards to the impact of wildlife trade activity on wild animal populations, it should be noted that there are a number of other causative factors (including those that are legal, political, epidemiological and environmental in nature) that can also affect the availability of a particular species at a given point in time. However, our aim was not to assess the extent of impact, rather we sought to identify those species that might potentially be at risk, to better understand what they

might be used for (by consumers) and to gain preliminary insights into the prescription and sale of plant-based alternatives (by vendors).

A full inventory of the wild animal species being sold at the “Marché des Fétiches” was beyond the scope of this study. Similarly, although vendors provided samples upon request, it was not possible to identify any of the local plant species from the dried specimens available. As such, we acknowledge that our use of local names to infer the species sold by vendors does not provide a complete taxonomic account. Furthermore, our use of local names likely means that, in some cases, vendors may be referring to only one particular species that is not threatened by extinction or vice versa. However, taxonomic inventories, based on direct observation, also have their limitations when considering the impact of traditional medicine on wildlife. For example, many traders sell individual bones or pieces of skin, making it impossible to determine how many individual animals are being traded in a particular market (Williams and Whiting 2016). In addition, traders are sometimes willing to use animals recovered dead from the wild rather than those killed specifically for use as traditional medicine (Williams and Whiting 2016). Despite the limitations of an interview-based approach, involving a relatively small number of vendors, we believe that our findings represent valuable information that can be used to help provide information for future efforts to protect wildlife in Togo.

Recommendations

The use of wild animals as traditional medicine involves multiple overlapping anthropological, ecological and behavioural aspects with a complexity that should not be underestimated (Williams and Whiting 2016). Although it is important to acknowledge an individual's reliance (World Health Organization 2002) or preference for traditional medicine (Whiting et al. 2011), the potential negative impacts of species exploitation on their conservation and welfare (Lambert et al. 2019) should also not be ignored, as ultimately the health and welfare of wildlife and people are inextricably linked and dependent on each other (Slorach 2013; OIE 2019). In particular, trade in live wild animals and their derivatives at markets that lack proper biosecurity have been specifically cited as a transmission mechanism of growing concern in recent decades (Can et al. 2019).

In addition to increased clarity regarding the domestic legislation and associated penalties (e.g. D'Cruze et al. 2020), increased research effort, focusing on the impacts of traditional medicine on both individual and wild animal populations, is required. We recommend that those wild animals already considered threatened by extinction (31 inferred species, including pangolin) and those with populations already thought to be in decline (65 inferred species) should be made a priority. However, we would also like to highlight that non-threatened wild animals, stated to have increased in rarity (70 inferred species), specifically those that are also considered to be highly profitable (such as python), should also not be overlooked in this regard.

During our survey, vendors stated that the majority of derivatives were used for spiritual use rather than medical purposes, with the most frequently cited benefit of using animals being to acquire “protection” (Fig. 1b). Furthermore detailed discussion with a larger sample size of vendors and an in-depth thematic analysis of content could be carried out to substantiate this finding and to explore potential nuances in relation to, for example, different product types and pricing. In addition, although not a focus of our research, future studies should look to collect data on how these derivatives are prepared and utilised. Clearly, additional research, focused on the socio-economic and societal pressures responsible for this type of consumer demand (including studies focused on consumer attitude and behaviour), is required and could be used to provide information for future initiatives aimed at minimising any negative impacts on people and wildlife. Given that a number of plant-based alternatives exist within the traditional medicine culture in West Africa, we also recommend additional research that could relieve pressure from over-exploited wildlife. For example, molecular studies could aid future taxonomic identification of plant species being sold as traditional medicine and weight-based price comparisons of plant-based alternatives with wildlife derivatives, could prove particularly useful in this regard. However, although such initiatives would not incur animal welfare costs, they would need to carefully ensure that conservation costs were not unintentionally transferred to these plant species. More research focused on the taxonomy, conservation status and uses of the plant-based products being sold in Togo is recommended in this regard.

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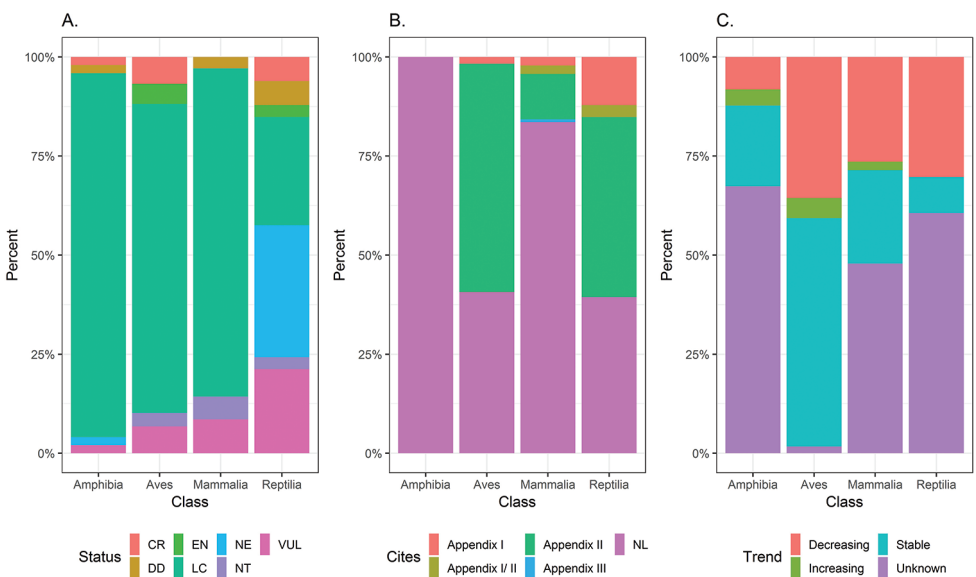
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Appendix I

Proportion of species potentially referred to using common name split by Class and IUCN status (A), by Class and CITES status (B) and Class and population trend (C).



Appendix 2

Summary of respondent questions relating to wildlife derivative sales.

Species	Mean min price per item USD (Range)	Mean max price USD (Range)	Total number of items sold last year (Range)	Most frequent purpose	Body part sold									
					All Parts	Bile	Bones	Feathers	Foot	Head	Live animal	Scales	Skin	Toes
Antelope	14.73 (10.2-17)	14.73 (10.2-17)	160	Make drums							X		X	
Baboon	19.55 (2.55-51)	36.55 (2.55-102)		Treat Elephantitis						X			X	
Bats	1.70 (0.85-2.55)	1.70 (0.85-2.55)		Heart Conditions	X									
Big Cats	86.98 (1.70-255)	115.32 (1.70-204)		Fetish Objects						X			X	
Cane Rat	7.86 (2.55-13.60)	7.86 (2.55-13.60)	115 35-40	Against Witchcraft	X						X			
Chameleón	2.05 (0.26-4.25)	2.05 (0.26-4.25)	915 (35-600)	Good Luck Charm	X						X			
Cobra	4.76 (3.40-8.50)	4.76 (3.40-8.50)	280 (10-200)	Anti-Venom	X					X	X		X	
Crocodile	24.79 (0.85-68)	33.29 (0.85-68)	70 (20-50)	Protect against drowning	X					X	X			
Eagle	17.85 (2.55-42.50)	17.85 (2.55-42.50)		Memory, treat ear infection, headaches	X			X		X			X	
Elephant	5.44 (1.70-13.60)	5.44 (1.70-13.60)		Treat Elephantitis	X				X				X	X
Frogs	0.34	0.34			X									
Hedgehog	4.25 (1.70-8.50)	4.25 (1.70-8.50)	65 (15-50)	Good Luck Charm, Protection, Treat ulcer	X						X			
Hippopotamus	765	765		Protection Against Mermaids						X				
Honey Badger	13.6	13.6	300	Protection							X			
Hyena	119.47 (3.40-340)	119.47 (3.40-3.40)		Protection, Fetish Object, Against Witchcraft						X			X	
Lion	59.88 (1.70-255)	79.33 (1.70-425)		Fetish Objects, Protection			X			X			X	X
Mice	2.13 (1.70-2.55)	2.13 (1.70-2.55)	15	Against Witchcraft						X				
Monitor Lizard	7.37 (5.10-8.50)	7.37 (5.10-8.50)												
Monkey	7.65 (5.10-10.20)	8.50 (6.80-10.20)	200	Help Memory, Fetish Objects	X						X			
Owl	5.44 (3.40-8.50)	5.44 (3.40-8.50)	50	Against Witchcraft	X						X			
Pangolin	26.88 (0.34-59.50)	26.88 (0.34-59.50)		Protection	X					X	X	X		
Parrot	36.19 (1.70-204)	36.19 (1.70-204)	80 (30-60)	Good Luck Charm	X			X		X	X			
Partridge	5.53 (2.55-8.50)	5.53 (2.55-8.50)		Good Luck Charm, Asthma		X				X				
Pied Crow	13.60	13.60	40	Against Witchcraft							X			
Porcupine														
Python	5.84 (2.55-8.50)	5.84 (2.55-8.50)	130 (10-100)	Protection	X					X	X		X	
Sea Turtle	76.50	76.50		Asthma	X									
Shrew	1.53 (0.51-2.55)	1.53 (0.51-2.55)	40	Love	X						X			
Sparrow Hawk	5.51 (0.34-11.90)	5.51 (0.34-11.90)	20	Protection, Ear Infections				X		X	X			

Supplementary material 1

Questionnaire

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Data type: questionnaire

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Supplementary material 2

Table S1. List of inferred species and their respective scientific names (assigned to each common name provided by questionnaire respondents) based on the documented presence of wild populations in Togo

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Data type: species data

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